CLAIMS

What is claimed is:

1. A method of operating a nuclear power plant through a fuel cycle of a core of a reactor of the plant, the core including a plurality of fuel rods in communication with a plurality of channels, and with a coolant flowing through the channels, the method comprising:

operating the plant at an initial power level during a first portion of the fuel cycle, the initial power level being based at least in part upon at least one of a maximum value of a heat flux peaking factor of the core and a maximum value of an enthalpy rise peaking factor of the core; and

operating the plant at an enhanced power level during a second portion of the fuel cycle, the enhanced power level being higher than the initial power level, the enhanced power level being based at least in part upon at least one of a reduced value of the heat flux peaking factor of the core and a reduced value of the enthalpy rise peaking factor of the core;

the reduced values of the heat flux peaking factor and the enthalpy rise peaking factor resulting from the progressive depletion of the core during the fuel cycle.

2. The method as set forth in Claim 1, in which the heat flux peaking factor is calculated according to the equation

$F_Q = (Q_{PEAK} / A_{PEAK}) / (Q_{TOT} / A_{TOT})$, where

F_Q = the heat flux peaking factor,

Q_{PEAK} = the heat flow from the fuel rod with the greatest heat generation rate,

A_{PEAK} = the surface area of the fuel rod with the greatest heat generation rate,

Q_{TOT} = the total heat flow from the core, and

A_{TOT} = the total surface area of the fuel rods;

the enthalpy rise peaking factor being calculated according to the equation

$F_{\Delta H} = (Q/W)_{PEAK} / (Q/W)_{AVG}$, where

$F_{\Delta H}$ = the enthalpy rise peaking factor,

Q = the heat generation rate of a fuel rod with respect to a flow channel,

W = the flow rate of the coolant through the channel, whereby

$(Q/W)_{PEAK}$ = the peak ratio of Q/W, and

$(Q/W)_{AVG}$ = the average ratio of Q/W; and

in which the step of operating the plant at an enhanced power level includes the steps of calculating the reduced heat flux peaking factor according to the equation

$F_{QR} = F_{QMAX} * P1 / P2$, where

F_{QR} = the reduced heat flux peaking factor,

F_{QMAX} = the maximum heat flux peaking factor,

P1 = the power output of the plant at the initial power level, and

P2 = the power output of the plant at a maximum power level,

and calculating the reduced enthalpy rise peaking factor according to the equation

$F_{\Delta HR} = F_{\Delta HMAX} * P1 / P2$, where

$F_{\Delta HR}$ = the reduced enthalpy rise peaking factor,

$F_{\Delta HMAX}$ = the maximum enthalpy rise peaking factor,

P1 = the power output of the plant at the initial power level, and

P2 = the power output of the plant at the maximum power level.

3. The method as set forth in Claim 2, in which the step of operating the plant at an enhanced power level includes the step of determining the maximum power level at least in part upon an assumption that at least one of at least a first performance condition of the plant is at a maximum level and at least a first process parameter of the operating environment is at an optimum level.

4. The method as set forth in Claim 2, in which the at least one of a reduced value of the heat flux peaking factor and a reduced value of the enthalpy rise peaking factor is the one of the reduced value of the heat flux peaking factor and the

reduced value of the enthalpy rise peaking factor which is achieved chronologically last by the heat flux peaking factor and the enthalpy rise peaking factor, respectively, during the fuel cycle.

5. The method as set forth in Claim 1, in which the step of operating the plant at an initial power level includes operating the plant at a power level that is based upon at least a first limiting design parameter of the plant, the plant including a margin in excess of the at least first limiting design parameter, and in which the step of operating the plant at an enhanced power level includes the step of operating the plant at a power level within the margin.

6. The method as set forth in Claim 1, in which the steps of operating the plant at an initial power level and operating the plant at an enhanced power level include the step of operating the plant at a substantially continuously variable power level in which the power level at a given moment is based at least in part upon at least one of a corresponding heat flux peaking factor and a corresponding enthalpy rise peaking factor.

7. The method as set forth in Claim 6, in which the step of operating the plant at an enhanced power level include at least one of the step of determining an instantaneous heat flux peaking factor and the step of determining an instantaneous enthalpy rise peaking factor.

8. A method of operating a nuclear power plant through a fuel cycle of a core of a reactor of the plant, the core including a plurality of fuel rods, the method comprising:

determining an initial power level based at least in part upon at least a first design limitation of the plant and at least one of a maximum value of a heat flux peaking factor of the core and a maximum value of an enthalpy rise peaking factor of the core;

determining a maximum power level based at least in part upon at least one of an assumption that at least a first performance condition of the plant is at a maximum level and an assumption that at least a first process parameter is at an optimum condition, the maximum power level being greater than the initial power level;

determining a reduced value of the heat flux peaking factor of the core based upon the maximum value of the heat flux peaking factor, the initial power level, and the maximum power level;

determining a reduced value of the enthalpy rise peaking factor of the core based upon the maximum value of the enthalpy rise peaking factor, the initial power level, and the maximum power level;

determining the one of the heat flux peaking factor and the enthalpy rise peaking factor that will achieve chronologically last the reduced value of the heat flux peaking factor and the reduced value of the enthalpy rise peaking factor, respectively, during the fuel cycle;

operating the plant at the initial power level during a first portion of the fuel cycle;

determining the one of the heat flux peaking factor and the enthalpy rise peaking factor of the core; and

operating the plant at an enhanced power level between the initial and maximum power levels during a second portion of the fuel cycle upon the one of the heat flux peaking factor and the enthalpy rise peaking factor achieving the reduced value of the heat flux peaking factor and the reduced value of the enthalpy rise peaking factor, respectively;

the reduced values of the heat flux peaking factor and the enthalpy rise peaking factor resulting from the progressive depletion of the core during the fuel cycle.

9. The method as set forth in Claim 8, in which the heat flux peaking factor is calculated according to the equation

$F_Q = (Q_{PEAK} / A_{PEAK}) / (Q_{TOT} / A_{TOT})$, where

F_Q = the heat flux peaking factor,

Q_{PEAK} = the heat flow from the fuel rod with the greatest heat generation rate,

A_{PEAK} = the surface area of the fuel rod with the greatest heat generation rate,

Q_{TOT} = the total heat flow from the core, and

A_{TOT} = the total surface area of the fuel rods;

the enthalpy rise peaking factor being calculated according to the equation

$F_{\Delta H} = (Q/W)_{PEAK} / (Q/W)_{AVG}$, where

$F_{\Delta H}$ = the enthalpy rise peaking factor,

Q = the heat generation rate of a fuel rod with respect to a flow channel,

W = the flow rate of the coolant through the channel, whereby

$(Q/W)_{PEAK}$ = the peak ratio of Q/W and

$(Q/W)_{AVG}$ = the average ratio of Q/W; and

in which the step of operating the plant at an enhanced power level includes the steps of calculating the reduced heat flux peaking factor according to the equation

$F_{QR} = F_{QMAX} * P1 / P2$, where

F_{QR} = the reduced heat flux peaking factor,

F_{QMAX} = the maximum heat flux peaking factor,

P1 = the power output of the plant at the initial power level, and

P2 = the power output of the plant at the maximum power level,

and calculating the reduced enthalpy rise peaking factor according to the equation

$F_{\Delta HR} = F_{\Delta HMAX} * P1 / P2$, where

$F_{\Delta HR}$ = the reduced enthalpy rise peaking factor,

$F_{\Delta HMAX}$ = the maximum enthalpy rise peaking factor,

P1 = the power output of the plant at the initial power level, and

P2 = the power output of the plant at the maximum power level.

10. The method as set forth in Claim 8, in which the step of operating the plant at an enhanced power level includes the step of operating the plant at a substantially continuously variable power level in which the power level at a given

moment is based at least in part upon at least one of a corresponding heat flux peaking factor and a corresponding enthalpy rise peaking factor.

11. The method as set forth in Claim 10, in which the step of operating the plant at an enhanced power level includes at least one of the step of determining an instantaneous heat flux peaking factor and the step of determining an instantaneous enthalpy rise peaking factor.

12. A method of operating a nuclear power plant through a fuel cycle of a core of a reactor of the plant, the method comprising:

determining a maximum power level for the reactor;

obtaining a license to operate the reactor at the maximum power level;

operating the reactor at an initial power level less than the maximum power level during a first part of the fuel cycle; and

operating the reactor at an enhanced power level during a second part of the cycle, the enhanced power level being between the initial power level and the maximum power level;

the increase in power level from the initial level to the enhanced power level being based at least in part upon the progressive depletion of the core during the fuel cycle.